JC03 Rec'd PCT/PTO 25 JUL 2001

(1390 REV. 5-93) US DEPT. OF COMMERCE PATENT & TRADEMARK OFFICE

ATTORNEY'S DOCKET NUMBER
110191

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

U.S. APPLICATION NO.
(if known, sec 37 C.F.R.1.5)
09/889932

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/NL00/00053	January 27, 2000	January 27, 1999

TITLE OF INVENTION
COMPACT ACTUATOR

APPLICANTS FOR DO/EO/US
Hendrikus Jan KAPAAN, Johannes Albertus VAN WINDEN, Jacobus ZWARTS, Thomas Wilhelm FUCKS

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.

2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.

3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).

4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.

5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)

6. ☐ A translation of the International Application into English (35 U.S.C. 371(c)(2)).

7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☐ have not been made and will not be made.

8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).

9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).

10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 11. to 16. below concern other document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.

12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.

13. ☒ A FIRST preliminary amendment.

    ☐ A SECOND or SUBSEQUENT preliminary amendment.

14. ☐ A substitute specification.

15. ☐ Entitlement to small entity status is hereby asserted.

16. ☒ Other items or information: submission of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

IC17 Rec'd PCT/PTO 25 JUL 2001

U.S. APPLICATION NO. (if known, see 37 C.F.R. 1.5) 09/889932	INTERNATIONAL APPLICATION NO. PCT/NL00/00053	ATTORNEY'S DOCKET NUMBER 110191

17. ☒ The following fees are submitted:	CALCULATIONS	PTO USE ONLY
Basic National fee (37 CFR 1.492(a)(1)-(5)):		
Search Report has been prepared by the EPO or JPO $860.00		
International preliminary examination fee paid to USPTO (37 CFR1.482) $690.00		
No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)) $710.00		
Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....$1,000.00		
International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4) .....$ 100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =	$860.00	
Surcharge of $130.00 for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).	$	

Claims	Number Filed	Number Extra	Rate		
Total Claims	33- 20 =	13	X $ 18.00	$234.00	
Independent Claims	2- 3 =	0	X $ 80.00	$	
Multiple dependent claim(s)(if applicable)			+ $270.00	$	
TOTAL OF ABOVE CALCULATIONS =				$1,094.00	
Reduction by 1/2 for filing by small entity, if applicable. -				$	
SUBTOTAL =				$1,094.00	
Processing fee of $130.00 for furnishing the English translation later than ☐ 20 ☐ 30 month from the earliest claimed priority date (37 CFR 1.492(f)). +				$	
TOTAL NATIONAL FEE =				$1,094.00	
				Amount to be refunded	$
				Charged	$

a. ☒ Check No. 121235 in the amount of $1,094.00 to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of $_____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Director is hereby authorized to charge any additional fees which may be required, or credit any overpayment, to Deposit Account No. 15-0461. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:
OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320

NAME: James A. Oliff
REGISTRATION NUMBER: 27,075

NAME: Thomas J. Pardini
REGISTRATION NUMBER: 30,411

Date: July 25, 2001

(1390 Rev.10-00)

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Hendrikus Jan KAPAAN, Johannes
Albertus VAN WINDEN, Jacobus ZWARTS,
Thomas Wilhelm FUCKS

Application No.: U.S. National Stage of PCT/NL00/00053

Filed: July 25, 2001 Docket No.: 110191

For: COMPACT ACTUATOR

PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE CLAIMS:

Please replace claims 5, 7, 10-11, 18-19, 21 and 26-32 as follows:

5. (Amended) Actuator according to claim 2, wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).

7. (Amended) Actuator according to claim 2, wherein the outer ring (10) of the bearing (11) supports a rotatable sleeve (31) which is in connection with the rotatable component (19) of the drive.

10. (Amended) Actuator according to claim 7, wherein the sleeve (31) is connected to the rotor (19) of the motor (3).

11. (Amended) Actuator according to claim 1, wherein one of the nut (4) and screw (5) is rotatably supported both according to an axis parallel with respect to said linear movement, and according to at least one axis transverse with respect to said linear movement.

18. (Amended) Actuator according to claim 16, wherein the teeth of the externally toothed member (24) are centred with respect to the ball joint (13).

19. (Amended) Actuator according to claim 14, wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).

21. (Amended) Actuator according to claim 19, wherein the outer ring (10) of the support bearing (11) is integrated with an internally toothed member (26).

23. (Amended) Actuator according to claim 19, wherein the rotor (19) of the motor (3) is rotatably supported on the outer ring of the support bearing (11).

26. (Amended) Actuator according to claim 19, wherein the rotor of the motor directly engages the outer ring of the support bearing.

28. (Amended) Actuator according to claim 13, wherein the screw (5) and the support shaft (16) each have a throughgoing bore, said bores being aligned with respect to each other.

29. (Amended) Actuator according to claim 1, wherein the screw (5) comprises a bore, said bore containing a grease dosing unit (53).

30. (Amended) Actuator according to claim 1, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a surface obtained by hard turning.

31. (Amended) Actuator according to claim 1, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a coating, e.g. a diamond-like carbon coating.

32. (Amended) Actuator according to claim 1, wherein an encoder is provided for measuring a relative rotation.

REMARKS

Claims 1-33 are pending. By this Preliminary Amendment, claims 5, 7, 10-11, 18-19, 21 and 26-32 are amended to eliminate multiple dependencies. Prompt and favorable examination on the merits is respectfully requested.

The attached Appendix includes marked-up copies of each rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Thomas J. Pardini
Registration No. 30,411

JAO:TJP/cmm

Attachment:
Appendix

Date: July 25, 2001

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400

DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our Deposit Account No. 15-0461

APPENDIX

Changes to Claims:

The following are marked-up versions of the amended claims:

5. (Amended) Actuator according to claim 2, ~~3 or 4,~~ wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).

7. (Amended) Actuator according to ~~any of claims 2-6,~~ claim 2, wherein the outer ring (10) of the bearing (11) supports a rotatable sleeve (31) which is in connection with the rotatable component (19) of the drive.

10. (Amended) Actuator according to claim 7, ~~8 or 9,~~ wherein the sleeve (31) is connected to the rotor (19) of the motor (3).

11. (Amended) Actuator according to ~~any of the preceding claims,~~ claim 1, wherein one of the nut (4) and screw (5) is rotatably supported both according to an axis parallel with respect to said linear movement, and according to at least one axis transverse with respect to said linear movement.

18. (Amended) Actuator according to claim 16 ~~or 17~~, wherein the teeth of the externally toothed member (24) are centred with respect to the ball joint (13).

19. (Amended) Actuator according to ~~any of claims 14-18,~~ claim 14, wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).

21. (Amended) Actuator according to claim 19 ~~or 20~~, wherein the outer ring (10) of the support bearing (11) is integrated with an internally toothed member (26).

23. (Amended) Actuator according to ~~any of claims 19-22,~~ claim 19, wherein the rotor (19) of the motor (3) is rotatably supported on the outer ring of the support bearing (11).

26. (Amended) Actuator according to claim 19 ~~or 20~~, wherein the rotor of the motor directly engages the outer ring of the support bearing.

28. (Amended) Actuator according to ~~claims 13-27,~~ claim 13, wherein the screw (5) and the support shaft (16) each have a throughgoing bore, said bores being aligned with respect to each other.

29. (Amended) Actuator according to ~~any of claims 1-28,~~ claim 1, wherein the screw (5) comprises a bore, said bore containing a grease dosing unit (53).

30. (Amended) Actuator according to ~~any of the preceding claims,~~ claim 1, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a surface obtained by hard turning.

31. (Amended) Actuator according to ~~any of the preceding claims,~~ claim 1, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a coating, e.g. a diamond-like carbon coating.

32. (Amended) Actuator according to ~~any of the preceding claims,~~ claim 1, wherein an encoder is provided for measuring a relative rotation.

PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of

Hendrikus Jan KAPAAN et al.

Application No.: 09/889,932

Filed: September 17, 2001 Docket No.: 110191

For: COMPACT ACTUATOR

SUPPLEMENTAL PRELIMINARY AMENDMENT

Director of the U.S. Patent and Trademark Office
Washington, D. C. 20231

Sir:

Prior to initial examination, please amend the above-identified application as follows:

IN THE CLAIMS:

Please replace claim 33 as follows:

33. (Amended) Brake calliper for a disc brake, comprising a claw piece carrying at least two opposite brake pads which enclose a gap for accommodating a brake disc, and an actuator according claim 1, said actuator having a housing accommodating a screw mechanism and a drive comprising a motor, said screw mechanism comprising a nut and a screw one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained, said housing being connected to the claw piece, characterised in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the screw which is rotatably supported with respect to the housing.

REMARKS

Claims 1-33 are pending. By this Preliminary Amendment, claim 33 is amended to eliminate multiple dependencies. Prompt and favorable examination on the merits is respectfully requested.

The attached Appendix includes marked-up copies of each rewritten claim (37 C.F.R. §1.121(c)(1)(ii)).

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Thomas J. Pardini
Registration No. 30,411

JAO:TJP/cmm

Attachment: Appendix

Date: September 17, 2001

OLIFF & BERRIDGE, PLC
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DEPOSIT ACCOUNT USE AUTHORIZATION
Please grant any extension necessary for entry;
Charge any fee due to our
Deposit Account No. 15-0461

APPENDIX

Changes to Claims:

The following is a marked-up version of the amended claim:

33. (Amended) Brake calliper for a disc brake, comprising a claw piece carrying at least two opposite brake pads which enclose a gap for accommodating a brake disc, and an actuator according to ~~any of the preceding claims,~~ claim 1, said actuator having a housing accommodating a screw mechanism and a drive comprising a motor, said screw mechanism comprising a nut and a screw one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained, said housing being connected to the claw piece, characterised in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the ~~nut or~~ screw which is rotatably supported with respect to the housing.

Compact actuator

The invention is related to an actuator, comprising a housing which contains a screw mechanism and a motor, said screw mechanism comprising a nut and a screw, one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained.

In certain applications, such as actuators for disc brakes, clutches etcetera, it is desirable to limit the overall dimensions and possibly the weight as much as possible. According to the invention, a compact layout may be obtained in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the screw which is rotatably supported with respect to the housing.

In particular, in case the screw is rotatably supported with respect to the housing by means of a support bearing, the screw may be integrated with the outer ring of the support bearing, such that the rotor of the motor, by means of an auxiliary bearing, is rotatably supported on the outer ring of the support bearing.

The support bearing is preferably accommodated with the auxiliary baring. In such embodiment, a compact and stuff support for the rotor and screw is obtained.

The linear movement provided by the actuator usually generates a force, e.g. in the case of a disc brake for clamping the brake pads onto the brake disc.

As a result of the inevitable flexibility of the actuator and the system to which said actuator is connected, elastic deformations are also generated.

In so far as these deformations are axial-symmetric with respect to the screw mechanism, no problems occur as to the proper function of the actuator. However, in certain cases, and in particular in the case of disc brakes, loads are generated which are eccentric with respect to the actuator.

The eccentricity is to be attributed to the asymmetric shape of the brake calliper, in particular of the claw piece thereof which carries the brake pads and which accommodates the brake disc sideways.

Upon pressing the brake pads onto the brake disc, the claw piece is loaded in bending, which bending action is also transferred onto the housing of the actuator. As the screw mechanism is supported within the housing, said mechanism may become exposed to bending as well.

The screw mechanism is however rather vulnerable with respect to misaligned forces, in such a way that the proper function may be hampered and that damage may occur.

The object of the invention is therefore to provide an actuator of the type described before, which is less vulnerable with respect to misaligned forces. This object is achieved in that the screw mechanism is supported with respect to the housing by means of a joint which allows rotations about at least one axis transverse with respect to said linear movement.

In case the housing of the actuator is loaded in bending, said bending action is relieved as a result of the freedom of the screw mechanism to rotate around the transverse axis or axes. Thus, the screw mechanism will not be exposed to misaligned forces.

In particular, one of the nut and screw is rotatably supported both according to an axis parallel with respect to said linear movement, and according to at least one axis transverse with respect to said linear movement. Said transverse rotation may be obtained by means of a ball joint.

Said ball joint may be situated at one end of a central support shaft, the other end of which is connected to the housing. According to a preferred embodiment, said ball joint may be connected to a support bearing supporting one of the nut and the screw, said one of the nut and the screw being drivably connected to the rotor of the motor.

The motor, preferably an electric motor, may engage the screw mechanism in several different ways. Usually, said motor is also connected to the housing, which means that the connection between the motor and the screw mechanism is also exposed to the elastic bending action of the housing under brake load.

Misalignment can be avoided here in case the nut and the screw engages the rotor through a coupling which allows rotations about at least one axis transverse with relation to the linear movement.

Said coupling may comprise an internally toothed member as well as an externally toothed member having equal number of teeth. The bending action of the housing can be accommodated in particular in case the teeth of the externally toothed member are convexly curved in a cross-section parallel to the linear movement, and in case the teeth of the externally toothed member are centred with respect to the ball joint.

A compact embodiment is obtained in case the outer ring of the bearing is integrated with an internally toothed member. The screw and the internally toothed member are at axially opposite ends of the outer ring.

Conveniently, the rotor of the motor is rotatably supported on the outer ring of the support bearing.

According to a first embodiment, the rotor engages an externally toothed member through a reduction gear mechanism. Preferably, the support bearing is supported on one end of a support shaft, the other end of which is connected to the housing, the externally toothed member being rotatably supported on said support shaft.

The invention will now be described with reference to the embodiments shown in the figures.

Figure 1 shows a first embodiment in longitudinal section.

Figure 2 shows an exploded view of the embodiment according to figure 1.

Figure 3 shows a second embodiment.

Figure 4 shows a third embodiment.

The actuator shown in figures 1 and 2 comprises a housing 1 containing a screw mechanism 2 and a motor 3. Said screw mechanism 2 comprises a nut 4 and a screw 5, provided with screw threads 6, 7 and which engage each other by means of a number of balls 8. At the location of the inserts 9, the balls are transferred between adjacent windings of the screw threads 6, 7.

The screw is integrated with the outer ring 10 of support bearing 11. The outer ring 10 has a larger diameter than the screw 5, for reasons of compactness of the actuator.

The inner ring 12 of the support bearing 11 is integrated with a ball joint 13. In particular, the inner ring has a spherical inner surface 14, which engages a ball 15 connected to the central support shaft 16.

Although the ball 15 is depicted as a separate part, it may also be carried out in one piece with the central support shaft 16. The central support shaft 16 is connected to the housing through the clip ring arrangement 17, and load cell 18 for measuring axial forces.

The rotor 19 of the motor 3 is supported with respect to the outer ring of the support bearing 11 by means of a sleeve 31 having integrated bearings 20. Said sleeve 31 is fixed to the stator 21. The stator 21 of the motor 3 is fixably connected to the

housing 1. Furthermore, the sleeve 31 is fixed to sleeve 32 of a reduction gear wheel mechanism 22.

By means of the reduction gear wheel mechanism 22, the motor 3 drives the sleeve 23, which carries an outwardly toothed member. This outwardly tooth member has teeth 25, which have a curved shape.

The outer ring 10 of the support bearing 11 carries an inwardly toothed member 26, which carries inwardly directed teeth with a correspondingly curved shape.

The number of outwardly directed teeth 25 and inwardly directed teeth 27 is equal. These teeth engage each other so as to transfer the driving action from the sleeve 23 onto the screw 5.

The nut 4 is carried out as a piston which is slidably held in a cylindrical space 28 in the housing 1. By means of pin 29 and groove 30 in the cylinder, said cylinder is held axially movable, but non-rotatable within the cylinder space 28.

Upon actuating the screw 5, the nut is therefore driven linearly and in axial direction with respect to the housing 1, e.g. for driving the brake pads of a brake calliper (not shown) towards and from each other.

In case, as a result of the forces generated in the housing 1, e.g. the housing of a brake calliper, a flexible bending is imposed thereon, the screw mechanism 2 is still protected against such loadings. Generally, screw mechanisms have a poor resistance against bending action, and the screw mechanism 2 in question is relieved from any bending loads due to the ball joint 13.

Also, the driving connection between motor 3 and screw mechanism 2 is relieved from any bending loads due to the teeth drive of the inwardly tooth member 26 and the outwardly tooth member 24, and the curved shape of the teeth in question.

The embodiment of figure 3 shows a brake calliper 40, comprising a housing 1 connected to claw piece 41 by means of screw thread. At its side facing the actuator 1, the claw piece 41 has a cavity 43 in which part of the stator 21 of motor 3 has been accommodated. Thereby, a very compact brake calliper 40 is obtained.

As usual, the claw piece 41 has a fixed brake pad 44 as well as a movable brake pad 45 which is connected to the nut 5 of the screw mechanism 2, in particular to the head 46 thereof.

Between the brake pads 44, 45, a brake disc 47 is accommodated.

The support shaft 16 supports the support bearing 11, the inner ring 12 thereof being

fixedly connected by means of e.g. a clip ring 48.

In this embodiment, the inner ring 12 of support bearing 11 has a closed head 49, such that a load cell 50 can be accommodated between said closed head 49 and the facing end of support shaft 16.

The other components of this embodiment are to a large extend identical to the embodiment of figures 1 and 2.

In the embodiment of figure 4, it is shown that the external teeth 25 of the externally toothed member 24 are rounded off in longitudinal cross-section, so as to better allow bending deformations of the housing, without however transferring the bending action onto the screw mechanism 2.

A grease-dosing unit 53 is accommodated in the base of the screw 5.

Claims

1. Actuator, comprising a housing (1) accommodating a screw mechanism (2) and a drive comprising a motor (3), said screw mechanism (2) comprising a nut (4) and a screw (5) one of which is rotatably supported with respect to the housing (1), such that upon relative rotation of the nut (4) and the screw (5) a linear movement of one of said nut (4) and screw (5) is obtained, characterised in that at least a rotatable component of the drive, e.g. the rotor (19) of the motor (3), is rotatably supported on the screw (5) which is rotatably supported with respect to the housing.

2. Actuator according to claim 1, wherein the screw (5) is rotatably supported with respect to the housing (1) by means of a support bearing (11).

3. Actuator according to claim 2, wherein the rotatable component of the drive, e.g. the rotor (19) of the motor (3) is rotatably supported on the screw (5) by means of an auxiliary bearing (52).

4. Actuator according to claim 3, wherein the support bearing (11) is accommodated within the auxiliary bearing (52).

5. Actuator according to claim 2, 3 or 4, wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).

6. Actuator according to claim 5, wherein the outer diameter of the outer ring (10) of the support bearing (11) is larger than the outer diameter of the screw (5).

7. Actuator according to any of claims 2 - 6, wherein the outer ring (10) of the bearing (11) supports a rotatable sleeve (31) which is in connection with the rotatable component (19) of the drive.

8. Actuator according to claim 7, wherein the sleeve (31) comprises, or is connected to, the integrated outer ring of an auxiliary bearing, the inner ring of which is integrated with the outer ring (10) of the support bearing (11).

9. Actuator according to claim 8, wherein the sleeve (31) comprises two axially spaced raceways, each of said raceways engaging a number of rolling elements (20) which each engage a raceway on the outer surface of the outer ring (10) of the support bearing (11).

10. Actuator according to claim 7, 8 or 9, wherein the sleeve (31) is connected to the rotor (19) of the motor (3).

11. Actuator according to any of the preceding claims, wherein one of the nut (4) and

screw (5) is rotatably supported both according to an axis parallel with respect to said linear movement, and according to at least one axis transverse with respect to said linear movement.

12. Actuator according to claim 11, wherein one of the nut (4) and screw (5) is supported with respect to the housing by means of a ball joint (13).

13. Actuator according to claim 12, wherein the ball joint (13) is at one end of a central support shaft (16), the other end of which is connected to the housing (1).

14. Actuator according to claim 13, wherein the ball joint (12) is connected to a support bearing (11), said support bearing (11) supporting the screw (5), said one of the nut (4) and the screw (5) being drivably connected to the rotor (19) of the motor (3).

15. Actuator according to claim 14, wherein said one of the nut (4) and the screw (5) engages the rotor (19) through a coupling (25, 27) which allows rotations about at least one axis transverse with relation to the linear movement.

16. Actuator according to claim 15, wherein the coupling comprises an internally toothed member (26) as well as an externally toothed member (24) having equal number of teeth (25, 27).

17. Actuator according to claim 16, wherein the teeth (25) of the externally toothed member (24) are convexly curved in a cross-section parallel to the linear movement.

18. Actuator according to claim 16 or 17, wherein the teeth of the externally toothed member (24) are centred with respect to the ball joint (13).

19. Actuator according to any of claims 14-18, wherein the screw (5) is integrated with the outer ring (10) of the support bearing (11).

20. Actuator according to claim 19, wherein the outer diameter of the outer ring (10) of the support bearing (11) is larger than the outer diameter of the screw (5).

21. Actuator according to claim 19 or 20, wherein the outer ring (10) of the support bearing (11) is integrated with an internally toothed member (26).

22. Actuator according to claim 20, wherein the screw (5) and the internally toothed member (26) are at axially opposite ends of the outer ring (10) of the support bearing (11).

23. Actuator according to any of claims 19-22, wherein the rotor (19) of the motor (3) is rotatably supported on the outer ring of the support bearing (11).

24. Actuator according to claim 23, wherein the rotor (19) engages an externally toothed member (24) through a reduction gear mechanism (22).

25. Actuator according to claim 24, wherein the support bearing (11) is supported on one end of a support shaft (16), the other end of which is connected to the housing (1), the externally toothed member (24) being rotatably supported on said support shaft (16).

26. Actuator according to claim 19 or 20, wherein the rotor of the motor directly engages the outer ring of the support bearing.

27. Actuator according to claim 26, wherein the rotor is integrated with an internally toothed member, and the outer ring of the support bearing is integrated with an externally toothed member, said members engaging each other.

28. Actuator according to claims 13-27, wherein the screw (5) and the support shaft (16) each have a throughgoing bore, said bores being aligned with respect to each other.

29. Actuator according to any of claims 1-28, wherein the screw (5) comprises a bore, said bore containing a grease dosing unit (53).

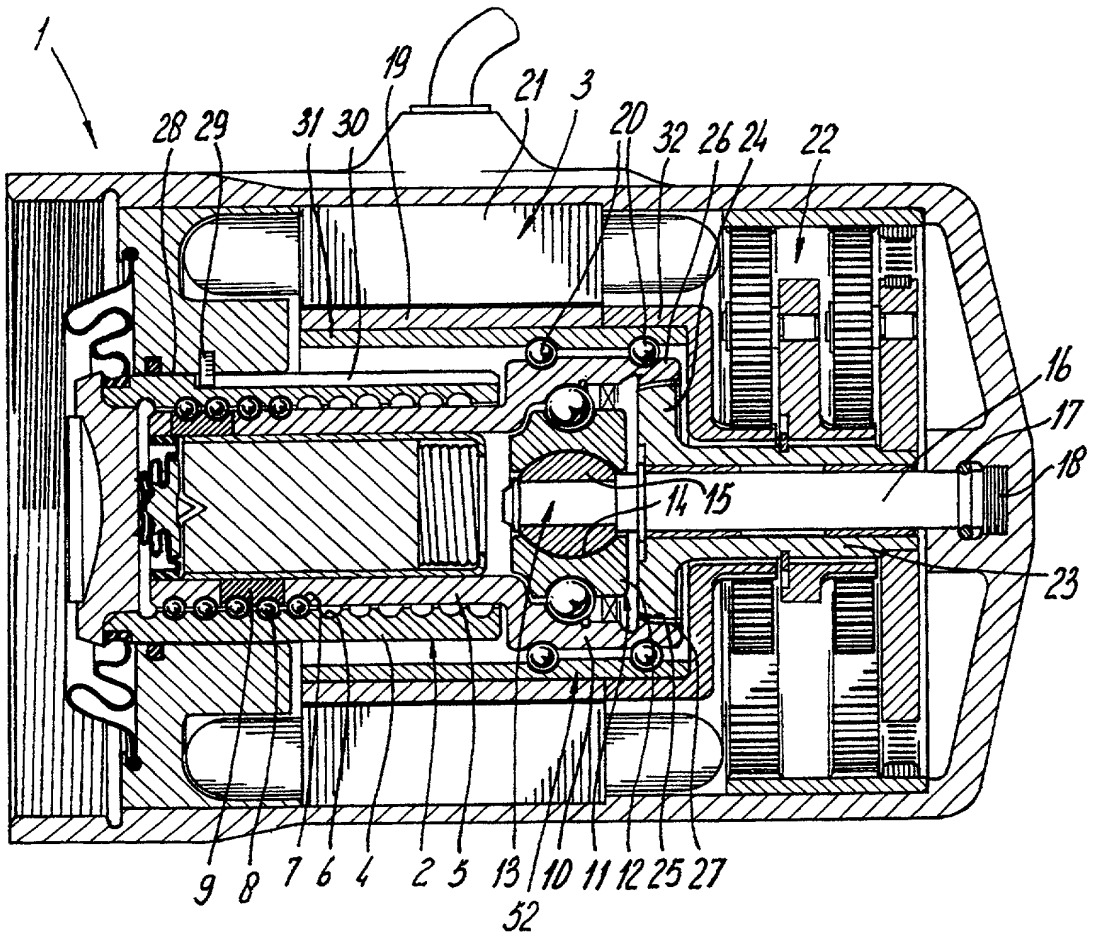
30. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a surface obtained by hard turning.

31. Actuator according to any of the preceding claims, wherein at least one of the components of the screw mechanism, support bearing, auxiliary bearing and reduction gear mechanism comprises a coating, e.g. a diamond-like carbon coating.

32. Actuator according to any of the preceding claims, wherein an encoder is provided for measuring a relative rotation.

33. Brake calliper for a disc brake, comprising a claw piece carrying at least two opposite brake pads which enclose a gap for accommodating a brake disc, and an actuator according to any of the preceding claims, said actuator having a housing accommodating a screw mechanism and a drive comprising a motor, said screw mechanism comprising a nut and a screw one of which is rotatably supported with respect to the housing, such that upon relative rotation of the nut and the screw a linear movement of one of said nut and screw is obtained, said housing being connected to the claw piece, characterised in that at least a rotatable component of the drive, e.g. the rotor of the motor, is rotatably supported on the ~~nut or~~ screw which is rotatably supported with respect to the housing.

fig-1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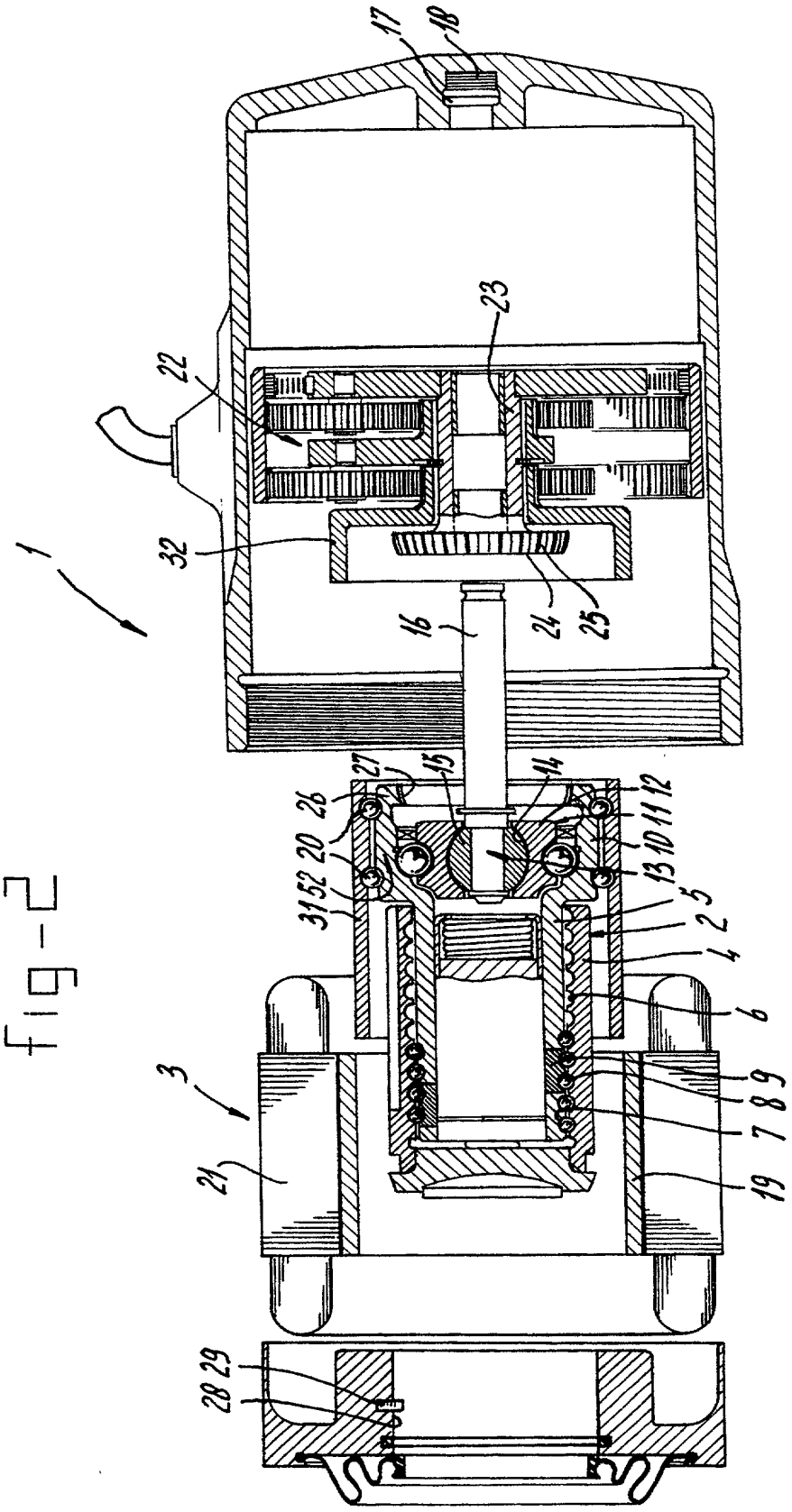
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Fig-2

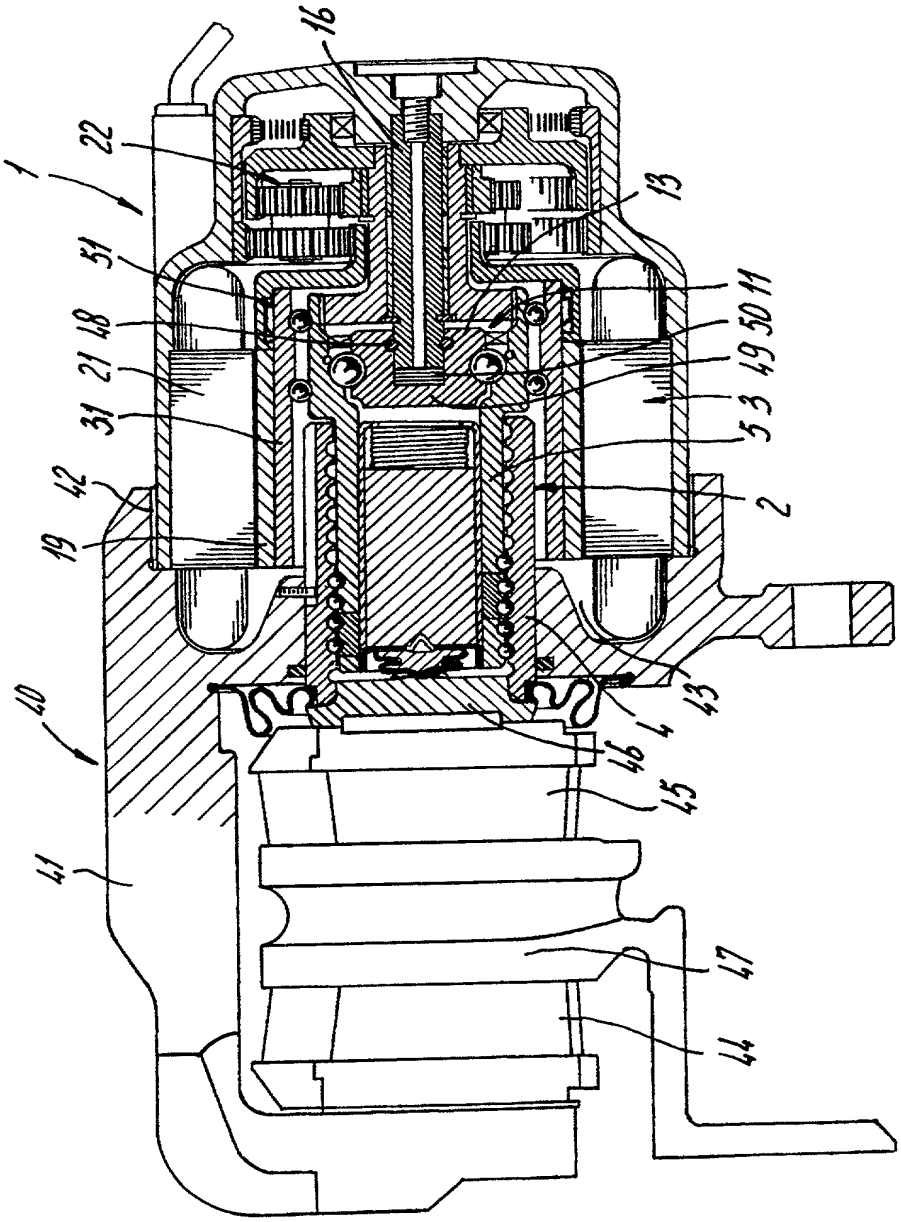
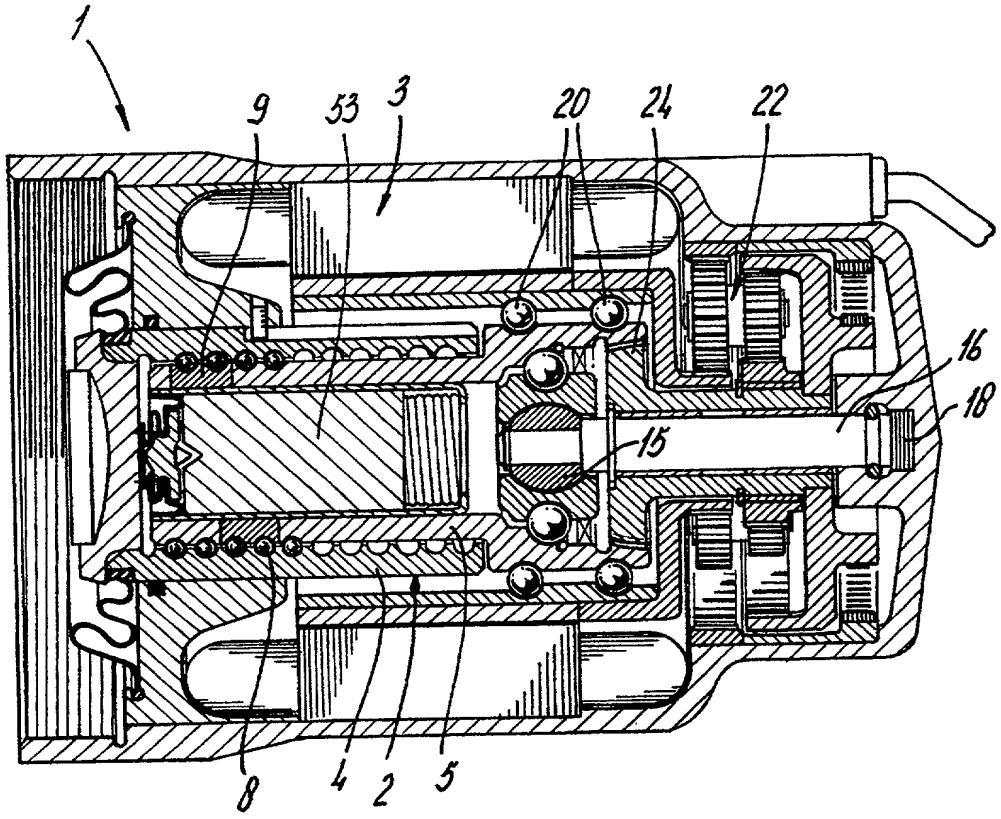


Fig-3

Fig-4



NL 99003 WO

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL DESIGN, NATIONAL STAGE OF PCT OR CIP APPLICATION)

As a below named inventor, I hereby declare that

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

Compact actuator

the specification of which: (complete (a), (b) or (c) for type of application)

REGULAR OR DESIGN APPLICATION

a. [ ] is attached hereto.
b. [ ] was filed on as Application
Serial No. and was amended on
(if applicable)

PCT FILED APPLICATION ENTERING NATIONAL STAGE

c. [X] was described and claimed in International application No. PCT/NL00/00053
filed on 27 January 2000
and as amended on (if any)

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, paragraph 1.56(a).

In compliance with this duty there is attached an information disclosure statement 37 CFR 1.97

PRIORITY CLAIM

I hereby claim foreign priority benefits under Title 35. United States Code paragraph 119 of any foreign application (s) for patent of inventor's certificate listed below and have also identified below any foreign application for patent of inventor's certificate having a filing date before that of the application on which priority is claimed.

(complete (d) or (e))

d. [ ] no such applications have been filed
e. [X] such applications have been filed as follows

EARLIEST FOREIGN APPLICATION(S), IF ANY FILED WITHIN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

Country	Application Number	Date of filing (day, month, year)	Date of Issue (day, month, year)	Priority claimed
the Netherlands	1011142	27 January 1999		Yes

ALL FOREIGN APPLICATION(S), IF ANY FILED MORE THAN 12 MONTHS (6 MONTHS FOR DESIGN) PRIOR TO SAID APPLICATION

_____

_____

CONTINUATION-IN-PART

(Complete this part only if this is a continuation-in-part application)

I hereby declare claim the benefit under Title 35, United States code, paragraph 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claim of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, paragraph 112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, paragraph 1.56(a) which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

_____

(Application Serial No.) (Filing date) (Status) (patented, pending, abandoned)

_____

(Application Serial No.) (Filing date) (Status) (patented, pending, abandoned)

POWER OF ATTORNEY

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

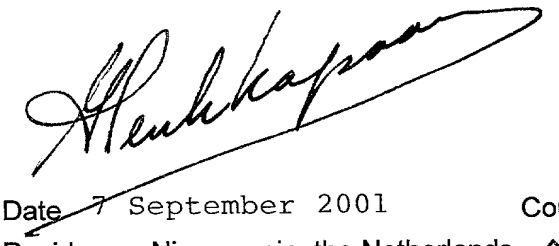
The undersigned, the above-noted Applicants, hereby revoke all previous powers of attorney and appoint the following as attorneys of record with full power of substitution and revocation to prosecute this patent application and all continuations and divisions thereof, and to transact all business in the Patent and Trademark Office:

James A. Oliff, Registration No. 27,075;
William P. Berridge, Registration No. 30,024;
Kirk M. Hudson, Registration No. 27,562;
Thomas J. Pardini, Registration No. 30,411; and
Edward P. Walker, Registration No. 31,4500.

ALL CORRESPONDENCE IN CONNECTION WITH APPLICATION SHOULD BE SENT TO OLIFF & BERRIDGE, P.O. BOX 19928, ALEXANDRIA, VIRGINIA 22320, TELEPHONE; (703) 836-6400.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that wilful false statements and the like so made are punishable by fine or imprisonment, or both under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00 Full name of first inventor: **KAPAAN, Hendrikus Jan**
Inventor's signature



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2-00 Full name of second inventor: **VAN WINDEN, Johannes Albertus**
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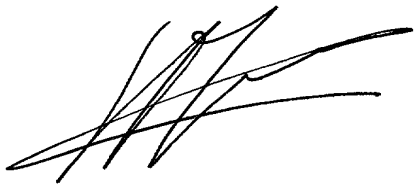
Inventor's signature



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4-00 Full name of fourth inventor: **FUCKS, Thomas Wilhelm**
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